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MEMOIRS OF THE HOURGLASS CRUISES

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STONY CORALS

I. Caryophylliina and Dendrophylliina (Anthozoa: Scleractinia)

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By

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ABSTRACT

Six species of coral belonging to the Scleractinian suborders Caryophylliina and Dendrophylliina were collected during Project Hourglass, including two new species. All species are described, illustrated and accompanied by synonymies. Five of the six species represent new distributional records for the Gulf of Mexico. A list of the 36 ahermatypes known from the Gulf of Mexico is presented. A key is provided for 32 ahermatypes reported from the eastern Gulf shelf and slope region.

INTRODUCTION

The ahermatypic coral fauna of the eastern Gulf of Mexico was first studied by Pourtalès in 1878, based on collections from three stations of the *Blake* off the Florida west coast in depths ranging from 183 to 1620 m. Pourtalès reported ten species of ahermatypic corals, seven of which

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were from the shallowest station at 183 m. Since 1878, however, few ahermatypes have been reported for the Gulf of Mexico (Moore and Bullis, 1960; Collard and d'Asaro, 1973; Tressler, 1974; Keller, 1975). Only Collard and d'Asaro mentioned records for the eastern Gulf of Mexico; the other references pertain to the northern and southern Gulf. Most recently, Cairns (1976), as part of a larger revision of the ahermatypes of the tropical western Atlantic, listed seven additional species from the eastern Gulf of Mexico fauna. Jaap (personal communication) has indicated the presence of two more shallow water species from the Florida west coast.

Twelve species of ahermatypes were collected by Project Hourglass. Six shallow water species belonging to the suborders Astrocoeniina and Faviina will be reported at a later date along with the hermatypic corals. The other six species, reported here, are deeper water species, all belonging to the suborders Caryophylliina and Dendrophylliina. Of these latter species, five are new records for the Gulf of Mexico.

Since ahermatypic corals do not contain zooxanthellae, they are not limited to the upper 100 m of sunlit waters, which the zooxanthellae require. This is not to say the ahermatypes are not found in shallow water. On the contrary, the ahermatypic genera *Astrangia* and *Phyllangia* (suborder Faviina) are rarely found deeper than 50 m, and species of *Caryophyllia* (suborder Caryophylliina) are found from the tide mark to 2700 m. Factors causing certain ahermatypic genera and families to be restricted to shallow or deep water are not fully known, but temperature restriction is probably most important, as well as substrate, water turbulence, competition and growth form.

ACKNOWLEDGMENTS

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METHODS AND MATERIALS

The corals were collected during Project Hourglass, a 28-month systematic sampling program conducted on the central west Florida shelf off Tampa Bay and Sanibel Island. The project was conducted by the Florida Department of Natural Resources Marine Research Laboratory and made use of the R/V *Hernan Cortez* for its monthly sampling stations. Complete descriptions of stations, sampling gear, methods and hydrographic data have been published by Joyce and Williams (1969) in this series. For convenience, a list of stations (Table 1) and a map of the study area (Figure 1) are provided. Hourglass Station E was originally located at 27°37′N, 84°21′W, in 91 m depth, but was relocated shoreward to 73 m depth after the first month (August, 1965) because of sampling difficulty. The August 1965 station is designated in quotation marks ("E") to avoid confusion with all subsequent collections from Station E in 73 m. Additional species records were obtained from specimens recently collected during the U.S. Department of Interior Bureau of Land Management (BLM) sponsored study of fauna of the eastern Gulf of Mexico Outer Continental Shelf.

TABLE 1. LOCATIONS AND DEPTHS OF HOURGLASS STATIONS.

Station	Latitude*	Longitude*	Established Depth (meters)	Approximate Nautical Miles Offshore*
A	27°35'N	82°50'W	6.1	4, due W of Egmont Key
B	27°37'N	83°07'W	18.3	19, due W of Egmont Key
C	27°37'N	83°28'W	36.6	38, due W of Egmont Key
D	27°37'N	83°58'W	54.9	65, due W of Egmont Key
E	27°37'N	84°13'W	73.2	78, due W of Egmont Key
"E"	27°37'N	84°21'W	91.5	86, due W of Egmont Key
I	26°24'N	82°06'W	6.1	4, due W of Sanibel Island Light
J	26°24'N	82°28'W	18.3	24, due W of Sanibel Island Light
K	26°24'N	82°58'W	36.6	51, due W of Sanibel Island Light
L	26°24'N	83°22'W	54.9	73, due W of Sanibel Island Light
M	26°24'N	83°43'W	73.2	92, due W of Sanibel Island Light

*U.S. Coast and Geodetic Chart No. 1003, dated June 1966

Types of most previously described species were examined from collections of the British Museum (Natural History) (BMNH), London; the Museum of Comparative Zoology (MCZ), Harvard University, Cambridge, Massachusetts; and the National Museum of Natural History, Smithsonian Institution (USNM), Washington, D.C. Holotypes and paratypes of the two new species described herein are deposited at the USNM. Single paratypes of the new species and all other Hourglass materials are deposited in the Invertebrate Reference Collection, Marine Research Laboratory, Florida Department of Natural Resources (collection prefix FSBC I). A repository for BLM specimens has not yet been designated.

Stereoscopically paired photographs of the two new species are presented. When used with a stereoscopic viewer, this technique is particularly useful to show depth of the fossa and relative heights of palar and columellar elements (Cairns, 1976).

Synonymies are complete unless otherwise stated.

Abbreviations used in the text are S_x, C_x, and P_x, collective terms for the septa, costae, or pali, respectively, of whatever cycle x represents.

SYSTEMATICS

Thirty-six species of ahermatypic corals are now known from the Gulf of Mexico, 32 of which have been recorded from the eastern Gulf; all are listed in Table 2. New combinations in this list are from Cairns (1976). All but nine of the Gulf ahermatypes belong to the suborders Caryophylliina and Dendrophylliina. The following key treats all eastern Gulf ahermatypes. Subsequent systematic accounts treat only those species of Caryophylliina and Dendrophylliina from Hourglass collections.

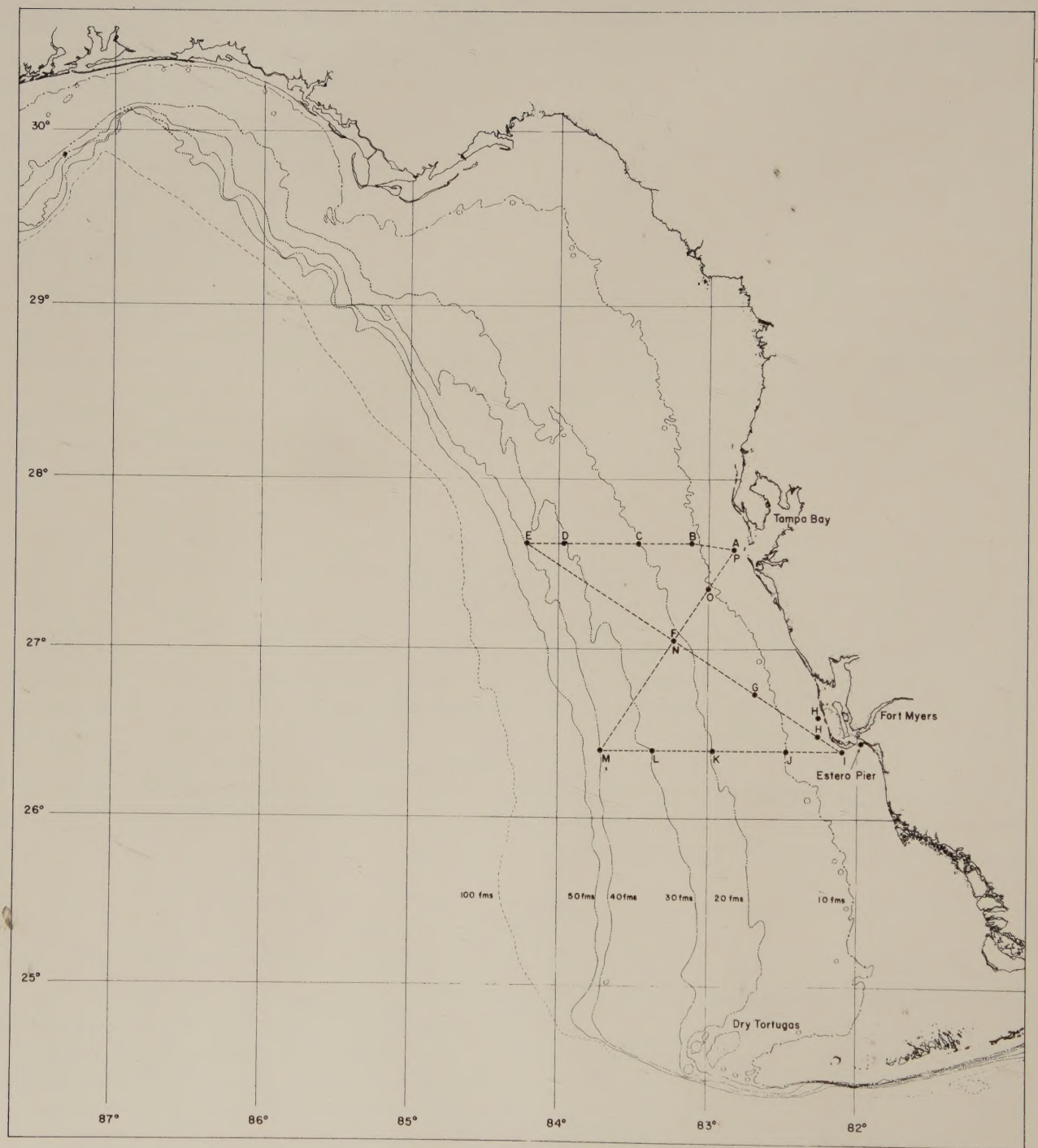

Figure 1. Hourglass cruise pattern and station locations.

TABLE 2. AHERMATYPIC CORALS OF THE GULF OF MEXICO.

Suborder Astrocoeniina
Family Pocilloporidae
Madracis myriaster (Milne-Edwards and Haime, 1849)
Madracis sp. cf. *asperula* Milne-Edwards and Haime, 1849

Suborder Fungiina
Family Fungiidae
Fungiacyathus crispus (Pourtalès, 1871)

Suborder Faviina
Family Faviidae
Cladocora debilis Milne-Edwards and Haime, 1849
Family Rhizangiidae
Astrangia astreiformis Milne-Edwards and Haime, 1849
Astrangia solitaria (Lesueur, 1817)
Phyllangia americana Milne-Edwards and Haime, 1849
Family Oculinidae
Madrepora carolina (Pourtalès, 1871), n. comb.
Oculina tenella Pourtales, 1871

Suborder Caryophylliina
Family Caryophylliidae
Caryophyllia berteriana Duchassaing, 1850
+*Caryophyllia horologium*, n. sp.
+*Caryophyllia maculata* (Pourtalès, 1874)
+*Paracyathus pulchellus* (Philippi, 1842)
Family Caryophylliidae (Continued)
Trochocyathus rawsonii Pourtalès, 1874
"Thecocyathus" laevigatus Pourtalès, 1871
Deltocyathus italicus (Michelotti, 1838)
Deltocyathus calcar Pourtalès, 1874
Sphenotrochus sp.
**Lophelia prolifera* (Pallas, 1766)
Peponocyathus stimpsonii (Pourtalès, 1871)
+*Dasmosmilia lymani* (Pourtalès, 1871)
Dasmosmilia variegata (Pourtales, 1871)
Anomocora fecunda (Pourtalès, 1871)
Coenosmilia arbuscula Pourtalès, 1874
Asterosmilia prolifera (Pourtalès, 1871)
Family Flabellidae
**Flabellum moseleyi* Pourtalès, 1880
+*Flabellum fragile*, n. sp.
Javania cailleti (Duchassaing and Michelotti, 1864), n. comb.
**"Rhizotrochus" fragilis* Pourtalès, 1868
Family Guyniidae
Guynia annulata Duncan, 1872
Stenocyathus vermiformis (Pourtalès 1868)
Schizocyathus fissilis Pourtalès, 1874

Suborder Dendrophylliina
Family Dendrophylliidae
+*Balanophyllia floridana* Pourtalès, 1868
Bathypsammia tintinnabulum (Pourtalès, 1868)
Enallopsammia profunda (Pourtalès, 1867)
**"Rhizopsammia" manuelensis* Chevalier, 1966

* not recorded for eastern Gulf of Mexico
\+ species treated here

KEY TO AHERMATYPIC CORALS OF THE SHELF AND SLOPE OF THE EASTERN GULF OF MEXICO

1. Solitary (only one calice present) 2

1. Colonial (branching; corallites united basally into quasi-colony; or parent corallite with numerous buds still attached) 24

2. Corallum attached 3

2. Corallum not attached (lying free on substrate) 15

3. Corallum porous, particularly noticeable near calicular edge 4

3. Corallum not porous 5

4. Costae present; septa arranged in Pourtalès Plan [some higher cycle septa (*i.e.*, S_5) larger than lower cycle septa (*i.e.*, S_3); S_5 joining as one septum and extending to columella] ..... *Balanophyllia floridana* Pourtalès

4. Costae absent, surface vermiculate; septa arranged normally [higher cycle septa progressively smaller, not meeting near columella] ..... *Bathypsammia tintinnabulum* (Pourtalès)

5. Adult corallum extremely small (rarely longer than 10 mm, calicular diameter less than 1 mm); septa arranged hexamerally or octamerally in only two cycles ..... *Guynia annulata* Duncan

5. Adult corallum with calicular diameter well over 1 mm; septa arranged hexamerally in three or more cycles 6

6. Pali (or paliform lobes) and columella present; costae present 7

6. Pali absent; columella rudimentary or lacking; costae absent (smooth, delicate epitheca) ... 14

7. Corallum attached to longitudinally split fragment of parent corallum 8

7. Corallum attached to substrate 9

8. First two cycles of septa (S_1 and S_2) often very thick, usually black ..... *Dasmosmilia variegata* (Pourtalès)

8. S_1 and S_2 not thick, never black ..... *Dasmosmilia lymani* (Pourtalès)

9. Pali present before septa of all but last cycle 10

9. Pali present only before septa of penultimate cycle 11

10. Pali often bilobed and indistinguishable from columellar elements; largest corallum known measures 15 mm in calicular diameter, 24 mm tall ..... *Paracyathus pulchellus* (Philippi)

10. Pali always single lobed and distinct from columella; corallum larger, measuring up to 26 mm in calicular diameter, 33 mm tall ..... *Trochocyathus rawsonii* Pourtalès

11. Columella composed of twisted trabeculae (fascicular) 12

11. Columella lamellar, spongy, or composed of pillars 13

12. Costae prominent, ridged; pedicel diameter narrow (10 to 30 per cent of calicular diameter); columellar elements usually fused to one another laterally ... *Caryophyllia horologium*, n. sp.

12. Costae usually flat; pedicel diameter larger (30 to 40 percent of calicular diameter); columellar elements usually distinct ..... *Caryophyllia berteriana* Duchassaing

13. Lower cycle septa (S_{1-3}) and costae speckled with brown; costae usually distinct and granulated ..... *Caryophyllia maculata* (Pourtalès)

13. All septa and costae white; costae not well defined, theca often porcellaneous ..... "*Thecocyathus*" *laevigatus* Pourtalès

14. Pedicel thin, but reinforced with concentric layers of stereome; inner edges of S_{1-2} usually straight ..... *Javania cailleti* (Duchassaing and Michelotti)

14. Pedicel very narrow, not reinforced with stereome; inner edges of S_{1-2} always sinuous. ..... *Flabellum fragile*, n. sp.

15. Corallum patellate or discoidal 16

15. Corallum conical, bowl-shaped, vermiform, or cuneiform (wedge-shaped) 18

16. Corallum extremely fragile, only collected in fragments; no pali ..... *Fungiacyathus crispus* (Pourtalès)

16. Corallum usually collected whole; pali before S_{1-3} 17

17. C_1 always broader than other costae; long costal spines usually associated with C_1; S_2 and C_2 usually black ..... *Deltocyathus calcar* Pourtalès

17. C_1 about same width as other costae; no long costal spines; not pigmented ..... *Deltocyathus italicus* (Michelotti)

18. Corallum cuneiform ..... *Sphenotrochus* sp.

18. Corallum conical, bowl-shaped or vermiform 19

19. Parricidal budding common. 20

19. No parricidal budding; corallum free 21

20. Parricidal budding usually from longitudinal fragment representing 1/6 of parent corallum; calicular diameter always less than 3.5 mm ..... *Schizocyathus fissilis* Pourtalès

20. Parricidal budding usually from calice of parent; calicular diameter averaging 10 mm. ..... *Asterosmilia prolifera* (Pourtalès)

21. Corallum vermiform ..... *Stenocyathus vermiformis* (Pourtalès)

21. Corallum bowl-shaped or conical. 22

22. Corallum small (calicular diameter rarely exceeding 7 mm); intercostal grooves very deep ..... *Peponocyathus stimpsonii* (Pourtalès)

22. Calicular diameter of adult greater than 7 mm; intercostal grooves not deep. 23

23. Pali before S_3 ..... *Caryophyllia horologium*, n. sp.

23. Pali or paliform lobes before all but last cycle of septa .... *Trochocyathus rawsonii* Pourtalès

24. Colonies branching 25

24. Quasi-colonial (corallites united by basal coenosteum) or one corallite with numerous buds still attached 31

25. Each calice containing only 10 septa 26

25. Each calice containing 24 or more septa arranged hexamerally in three or more cycles. 27

26. Branches slender (to 3 mm); intercalicular surface spiny . . . . . *Madracis* sp. cf. *asperula* Milne-Edwards and Haime

26. Branches thicker (to 8 mm); intercalicular surface striate . . . . . *Madracis myriaster* (Milne-Edwards and Haime)

27. Calices occurring only at ends of branches 28

27. Calices occurring on sides of branches. 29

28. Branches long, cylindrical, rarely over 4 mm in diameter; pali before S_2 . . . . . *Cladocora debilis* Milne-Edwards and Haime

28. Each corallite forming a branch tapered toward proximal end; calicular diameter up to 15 mm; no pali. . . . . *Coenosmilia arbuscula* Pourtalès

29. Branches porous, especially near calices . . . . . *Enallopsammia profunda* (Pourtalès)

29. Branches not porous 30

30. Calicular diameter 2.0 to 2.5 mm; pali before S_1 and S_2 . . . . . *Oculina tenella* Pourtalès

30. Calicular diameter 3.5 to 5.5 mm; no pali . . . . . *Madrepora carolina* (Pourtalès)

31. Corallum composed of small cluster of corallites, all united basally by common coenosteum or by stolon-like expansions 32

31. Corallum composed of one large corallite with numerous buds still attached or scars of previous attachments . . . . . *Anomocora fecunda* (Pourtalès)

32. Corallites united by stolon-like expansions, eventually losing organic connection . . . . . *Astrangia solitaria* (Lesueur)

32. Corallites united basally by common coenosteum, rarely losing organic connection 33

33. Colony forming phaceloid clumps; calicular diameter over 10 mm 34

33. Colonies cerioid; calicular diameter 3 to 4 mm. . . . . *Astrangia astreiformis* Milne-Edwards and Haime

34. S_1 and S_2 about equal size; large coralla with S_6; brown speckles on lower cycle costae and septa . . . . . *Caryophyllia maculata* (Pourtalès)

34. S_1 more exsert than S_2; large coralla rarely with S_5; not speckled, often brownish overall . . . . . *Phyllangia americana* Milne-Edwards and Haime

SUBORDER CARYOPHYLLIINA VAUGHAN AND WELLS, 1943
Superfamily Caryophylliicae Gray, 1847
Family Caryophylliidae Gray, 1847
Genus *Caryophyllia* Lamarck, 1801

Caryophyllia maculata (Pourtalès, 1874)

Plate I, Figures 1-3

Coenocyathus cylindricus: Duchassaing, 1870, p. 25 [not *Coenocyathus cylindricus* Milne-Edwards and Haime, 1848].

Bathycyathus maculatus Pourtalès, 1874, pp. 34, 35, pl. 6, figs. 5, 6.

Caryophyllia maculata: Pourtalès, 1880, pp. 96, 101; Moseley, 1881, pp. 139, 140 [in part: *Challenger* Sta. 122], pl. 4, figs. 8, 8a; Goreau and Wells, 1967, p. 449; Laborel, 1970, p. 175; Wells, 1972, p. 6; Wells and Lang, 1973, p. 58; Zibrowius, 1974, p. 755; 1976, p. 147.

Coenocyathus bartschi Wells, 1947, pp. 170, 171, pl. 11, figs. 1-3.

not *Caryophyllia maculata*: Squires, 1958a, p. 91; 1961, p. 19 [=*Caryophyllia profunda* Moseley, 1881].

not *Caryophyllia* cf. *C. maculata*: Ralph and Squires, 1962, p. 7; Squires and Keyes, 1967, p. 23 [=*Caryophyllia profunda* Moseley, 1881].

Material examined: HOURGLASS STATION M: 1; 13 January 1967; dredge; FSBC I 15283.

Description: Corallites cylindrical, round to elliptical in cross section, firmly attached by thin, encrusting base, giving rise extratentacularly to other corallites, producing quasi-colony. Largest known corallite 22.7 x 19.1 mm in calicular diameter, 33.8 mm in height (corallite one of six interconnected corallites forming small phaceloid clump). Equal, flat to slightly convex costae, separated by shallow, narrow intercostal furrows, usually extending from calice to base and even onto encrusting base Costae bearing large, rounded, blunt granules such that three can be counted across width of each costa near calice. Theca smooth, without costae or granulation on larger corallites. Costae often speckled with brown near calicular edge.

Septa usually hexamerally arranged in 12 half-systems, but large corallites with 11 or 13 complete half-systems are common. Calicular diameter and number of septa directly related. Fourth cycle of septa (48 total septa) usually complete at calicular diameter between 8 and 10 mm; fifth cycle (96 total septa) between 11 and 15 mm; septa of sixth cycle (up to 112 septa) often present in large specimens. S_1 equal to or slightly larger than S_2, exsert, with straight, vertical inner edges almost reaching columella; upper calicular edges of S_{1-3} speckled with brown, speckles in larger specimens arranged in bands perpendicular to thecal edge. Remaining cycles of septa progressively less exsert, not extending as far toward columella. Last cycle of septa (S_4, S_5 or S_6) often rudimentary, with highly laciniate edges; otherwise, inner edges of other septa smooth, straight. Low, pointed granules covering septal and palar faces.

Palus very large, with rounded upper margin, present before each S_3 in small specimens lacking S_5; palus separated from its septum by deep narrow notch and extending to columella. [However,

with addition of S_5 to a half-system, each original P_3 is realigned with one of two S_4 in the half-system (becoming, in effect, P_4), while a new P_4 is formed before the other S_4 in the half-system, ultimately producing 24 pali (P_4) in a corallite with 96 septa (five complete cycles)].

Fossa moderately deep, bearing elongate, variable columella, usually composed of tangled mass of fused trabeculae but sometimes lamellar or arranged as row of several distinct pillars.

Types: One syntype; MCZ 2783.

Type locality: Off Abrolhos, Brazil; 55 m.

Distribution: Bahamas; Straits of Florida; off west Florida; Yucatan Channel; off Jamaica; Lesser Antilles; off Curaçao; off Barra Grande and Abrolhos, Brazil; 3-161 m.

Remarks: *C. maculata* clearly does not belong in the genus *Caryophyllia* or *Coenocyathus*, but is placed in *Caryophyllia* for convenience. Recent observations indicate that it probably represents a new genus in the Parasmiliinae. It is easily distinguished from the other 11 valid species (Cairns, 1976) of western Atlantic *Caryophyllia* by the presence of pali before the fourth cycle (not the third or second), and its maculated septa and costae.

The single specimen collected by Project Hourglass, measuring 18.5 x 16.4 mm in calicular diameter and 16.4 mm in height, was long dead when collected. It is quite worn and entirely encrusted with bryozoans and algae.

Caryophyllia horologium, new species

Plate I, Figures 4-6, 9

Material examined: HOURGLASS STATION "E": 4; 4 August 1965; dredge; (HOLOTYPE, USNM 45760; 2 PARATYPES, USNM 45762; 1 PARATYPE, FSBC I 15282). – OTHER MATERIAL: 1 PARATYPE; west of Cedar Key, Florida, 55 m; July 1963; USNM 45761. – 1 PARATYPE; off Sanibel Island, Florida, 55 m; October 1964; USNM 45763. – 1; BLM Sta. 33 II B, 27°50′N, 84°31′W, 91 m; 27 February 1976. – 2; BLM Sta. 22 I B, 26°25′N, 83°50′W, 91 m; 22 October 1975.

Description: Corallum trochoid in shape, narrowing to slender monocyclic pedicel measuring 10 to 30 percent diameter of calice; narrow pedicel providing rather insecure, easily broken attachment; calice round to elliptical. Holotype (largest specimen) 14.6 x 10.9 mm in calicular diameter, 18.8 mm in height. C_{1-3} highly ridged, especially near calice, becoming less prominent toward base. Area corresponding to C_4 slightly ridged or broad and flat, covered by prominent, pointed granules (about two to three across width of each C_4 near calice). Granules also occurring on thin ridges of C_{1-3}, becoming lower and blunter toward base.

Septa arranged in six systems and four cycles, sometimes with S_5 present. Holotype with 13 half-systems as result of abnormality caused by fracture and subsequent repair of corallum. S_1 and S_2 equal in size, exsert, extending almost to columella, their upper edges rounded and inner edges vertical and slightly sinuous. S_3 smaller, less exsert, extending only half distance to columella, with very sinuous inner edges. S_4 small, rudimentary, lower in fossa, with straight inner edges. S_5 occurring in pairs when present, each pair flanking an S_4; in such instances, S_4 enlarging to size of S_3, and S_5 about same size as normal S_4. Tall, blunt, widely spaced granules covering all septal faces.

Pali large, compressed in plane of septum, occurring before each S_3; each palus separated from its septum by deep, narrow notch; pali with sinuous inner and outer margins, rounded upper margins and covered by prominent granules slightly larger than septal granules. Fascicular columella elongate, composed of closely fused mass of broadly twisted ribbons; inner edges of pali fused with columella.

Color of preserved tissue mauve.

Type locality: Hourglass Station "E", 27°37′N, 84°21′W; 91 m depth; about 86 nmi west of Egmont Key, Florida west coast.

Distribution: Known only from the west Florida shelf from Sanibel Island to Cedar Key; 55-91 m.

Etymology: The specific name *horologium*, from the Greek, means hourglass. It is named in honor of Project Hourglass.

Remarks: *Caryophyllia horologium* is similar to *C. berteriana* Duchassaing, 1850, but differs by possessing a narrower base of attachment, more prominent costal granulation, distinct, ridged costae, and columellar pillars which are usually solidly fused to one another, not individualized as in *C. berteriana*. Furthermore, *C. berteriana* is known from 100-850 m whereas *C. horologium* is not known deeper than 91 m.

Genus *Paracyathus* Milne-Edwards and Haime, 1848

Paracyathus pulchellus (Philippi, 1842)

Plate II, Figures 2, 3

Synonymy complete for western Atlantic only:
Cyathina pulchella Philippi, 1842, p. 42.

Paracyathus pulchellus: Milne-Edwards and Haime, 1857, p. 55; Squires, 1959, p. 13; Lewis, 1965, p. 1062; Zibrowius, 1976, pp. 96-100, pl. 29, figs. A-K, pl. 30, figs. A-L.

Paracyathus defilippi Duchassaing and Michelotti, 1860, p. 60, pl. 9, figs. 2, 3; 1864, p. 65; Duchassaing, 1870, p. 25; Pourtalès, 1874, p. 38; 1878, p. 200; 1880, pp. 96, 105; Moseley, 1881, p. 144 [in part: off Azores]; Vaughan, 1901, p. 292; Gardiner and Waugh, 1938, p. 182; Durham, 1949, p. 156; Squires, 1959, pp. 12-15; Lewis, 1965, p. 1062; Goreau and Wells, 1967, p. 449; Porter, 1972, p. 113; Wells and Lang, 1973, p. 58; Keller, 1975, p. 178.

Paracyathus confertus Pourtalès, 1868, p. 134; 1871, p. 11, pl. 6, figs. 11-13; Studer, 1878, p. 628; Agassiz, 1888, pp. 149, 150, fig. 466; Squires, 1958b, p. 258.

Material examined: HOURGLASS STATION "E": 1; 4 August 1965; dredge; FSBC I 15284.

Description: Shape of corallum variable. Young specimens often short, cylindrical, but sometimes conical; larger specimens usually elongate-conical, tapering to rather narrow pedicel measuring one-fourth to one-half calicular diameter and re-expanding into encrusting, polycyclic base. Calice usually elliptical, but sometimes perfectly round or strongly compressed. Largest known corallum, 15.5 x 13.3 mm in calicular diameter, 24.0 mm tall, containing 76 septa. Costae usually conspicuous only near calicular edge as low, slightly convex ridges, separated by narrow, shallow intercostal furrows, but sometimes highly ridged, separated by broad, deep intercostal furrows and extending to base. Costal granulation, when expressed, consisting of low, rounded granules. Proximal two-thirds of corallum often covered by encrusting organisms (*e.g.*, bryozoans, algae, foraminifera), often giving white appearance. Bands of epitheca occasionally deposited in this area, also contributing to milky-white exterior. Otherwise, distal part of corallum and septa usually light or dark brown or reddish brown.

Septa arranged in six systems and five cycles. S_5 appearing at calicular diameters above about 8 mm, but full fifth cycle (96 total septa) never attained. One pair of S_5 usually occurring in all twelve half-systems before second pair added to any half-system. S_1 and S_2 equal in size, moderately exsert. Higher cycle septa progressively smaller, less exsert. Inner edges of all septa straight to slightly sinuous. Septal faces with prominent, pointed or rounded granules sometimes fusing to form horizontal ridges at axial margin, making septa appear thick.

Pali most variable character of species, occurring before all but last cycle, tall, compressed in plane of septum, usually bearing granulation more prominent than that of septa; each palus separated from respective septum by deep, narrow notch. P_1 and P_2 equal in size, lowest in fossa, closest to columella. P_3 usually twice as large, terminating higher in fossa, often wedge-shaped, with calicular edges considerably broader than axial edges. P_4 about same size as P_3, recessed from columella, terminating even higher in fossa than P_3. Often two to four additional paliform lobes (multi-lobate) in space between axial edge of P_4 and columella, of progressively smaller size nearer columella; innermost lobes sometimes indistinguishable from columella.

Fossa extremely variable in depth, usually deep, but ranging from very deep to level with upper edges of septa; last condition rare. Columella large, usually elliptical, composed of up to 60 close-set, uniform, slender rods, all terminating at same level below that of pali. Columellar elements interconnected basally, fused to inner edges of sometimes indistinguishable paliform lobes.

Types: Syntypes of *C. pulchellus* (from Trapani, numbers 549 and 552) are at the Berlin Museum. The holotype of *P. defilippi*, a small specimen of 44 septa measuring only 4.0 x 4.4 mm in calicular diameter, is in the Museo ed Istituto di Zoologia Sistematica, Torino (Coel. 229). Eight syntypes of *P. confertus*, divided into three lots, are deposited at the MCZ (all numbered 5481); one lot is from *Bibb* Sta. 39P, but localities of the other two are unknown.

Type locality: Off Naples and Trapani, Mediterranean.

Distribution: Western Atlantic: Blake Plateau to 32°08′N, 79°16′W; Straits of Florida; Bahamas; Antilles; coastal Caribbean; off entire west coast of Florida to Pensacola; off Texas; off French Guiana. Eastern Atlantic: Mediterranean; in the area bounded by Portugal, the Azores, and the Gulf

of Guinea. Most common between 50-250 m depths; however, confirmed extremes range from near the surface to 1225 m (Zibrowius, 1976).

Remarks: *Paracyathus defilippi* is synonymized here for the first time with the common eastern Atlantic *P. pulchellus*, resulting in one extremely variable species with an amphi-Atlantic distribution. Differences among western Atlantic specimens, even within the same lot, are sometimes far greater than those observed in specimens from opposite sides of the Atlantic. Furthermore, the occidental specimens agree in every respect with the detailed description given by Zibrowius (1976) of *P. pulchellus*, based exclusively on hundreds of eastern Atlantic specimens. Squires (1959) was the first to state that both *P. defilippi* and *P. pulchellus* were amphi-Atlantic. However, he maintained that they were different species: *pulchellus* had single-lobed pali, whereas *defilippi* had multi-lobate pali. Squires was working with a small number of specimens (40); in a larger suite, every gradation is expressed, sometimes even within the same corallum.

Zibrowius (1976) should be consulted for a complete synonymy of eastern Atlantic references.

The Hourglass specimen was alive when collected. It is 9.7 x 8.8 mm in calicular diameter and contains 64 septa.

Genus *Dasmosmilia* Pourtalès, 1880

Dasmosmilia lymani (Pourtalès, 1871)

Plate I, Figures 7, 8

Parasmilia lymani Pourtalès, 1871, p. 20, pl. 6, figs. 8-10; Verrill, 1882a, p. 316; 1882b, pp. 406, 407.

Dasmosmilia lymani: Pourtalès, 1880, pp. 96, 108; Verrill, 1883, p. 64; 1885, p. 535, fig. 17; 1908, p. 449; Chevalier, 1966, p. 949; Tommasi, 1969, p. 56, fig. 2; Laborel, 1969, p. 155; 1970, p. 175; Zibrowius, 1976, pp. 142, 143, pl. 26, figs. A-L, pl. 27, figs. A-L.

Material examined: HOURGLASS STATION E: 1; 4 January 1966; dredge; FSBC I 15285.

Description: Corallum cylindrical or conical, often slightly curved, usually with broken base or attached to sector of older corallum of same species; individuals attached to substrate extremely rare. Calice triangular, rectangular, round, or elliptical. Strongly compressed calices attaining 28 mm in greater diameter, with corallum height 50 mm; some entire populations with calicular diameters never exceeding 14 mm and heights never exceeding 30 mm. Costae variable, usually ridged, equal, separated by broad, flat, intercostal furrows; costae sometimes unequal (more prominent costae alternating with less prominent ones), rounded or flattened, separated by narrow, shallow, intercostal spaces. Low, rounded costal granules arranged near calicular edge such that two to four occur across width of each costa. Theca and septa very fragile, often light brown.

Septa arranged in six systems and five cycles, last cycle rarely complete. S_{1-3} equal, slightly exsert; each septum may bear thin, small paliform lobe on inner edge; otherwise, septum merging with columella. S_4 smaller, less exsert, usually with sinuous inner edges, with much larger paliform lobes sometimes dissected into two lobes, both merging with columella. S_5 smaller, not reaching

columella. Ideal condition of 96 septa rare; usually 12 to 22 larger septa (S_{1-3}) with or without paliform lobes, 12 to 22 paliferous septa (S_4), and 24 to 44 S_5, resulting in 12 to 22 quartets of septa composed of three different sizes. Granules on larger septa somewhat cup-shaped, often joined together, forming curved lines perpendicular to septal edge.

Columella (called false columella by Pourtalès in 1871) composed of numerous crispate, twisted processes originating from lower inner edges of S_{1-3} deep in fossa; columella sometimes absent or greatly overshadowed by numerous lamellar paliform lobes.

Types: Forty-nine syntypes, divided into six lots, bearing the numbers 2770, 5625, and 5469, are deposited at the MCZ. Of the six stations at which syntypes were collected, only three (*Bibb* Stas. 187, 194 and 203) are known for certain. Two additional specimens, perhaps also syntypes, are at the BMNH (1891.2.4.27 and 1970.1.26.33).

Type locality: Off Florida Keys; 128-269 m.

Distribution: Western Atlantic: off eastern United States (to 41°N); Straits of Florida; Florida west coast to off Apalachicola; off Venezuela; off Guyana; off Cabo Frio, Brazil (23°S). Eastern Atlantic: in the area bounded by Portugal, the Azores, and Sahara Occidental; 73-305 m.

Remarks: The commonest mode of reproduction in this species is asexual budding from wedge-shaped pieces of a parent corallum that have probably resulted from accidental breakage or crushing. Verrill (1908) suggested that fish and large crustaceans were responsible for the longitudinal splitting of the very fragile theca. Verrill (1882a) reported as many as 30 buds from one broken sector.

The Hourglass specimen was probably alive or recently dead when collected. It measures 18.4 x 10.9 mm in calicular diameter, 29.4 mm tall, and contains 110 septa.

Superfamily Flabellicae Bourne, 1905
Family Flabellidae Bourne, 1905
Genus *Flabellum* Lesson, 1831

Flabellum fragile, new species
Plate II, Figures 1, 4-6, 9

Material examined: HOURGLASS STATION "E": 3; 4 August 1965; dredge; (HOLOTYPE, USNM 45764; 1 PARATYPE, USNM 45766; 1 PARATYPE, FSBC I 15286). – OTHER MATERIAL: 1 PARATYPE; west of Egmont Key, Florida, 366 m; USNM 45765. – 1 PARATYPE; southeast of Alligator Reef, Florida, 183-212 m; USNM 45767. – 3; BLM Sta. 33 III C, 28°24′N, 85°15′W, 183 m; 26 February 1976. – 1; BLM Sta. 33 II C; 27°50′N, 84°42′W, 183 m; 27 February 1976.

Description: Corallum trochoid to turbinate in shape, with basal angle of about 50°, tending to become cylindrical with continued growth. Pedicel very narrow (often only one-tenth calicular diameter), not reinforced by stereome, often slightly bent. Adult coralla often not firmly attached, but base usually containing small, hard object. Calice elliptical; holotype 18.2 x 16.6 mm in calicular diameter, 19.4 mm tall; largest known specimen 20.0 x 17.4 mm in calicular diameter, only 17.2 mm tall. Epithecal wall very thin, bearing chevron-shaped growth lines forming apices at upper, outer edge of every S_{1-3}; epitheca usually encrusted by foraminifera, polychaetes, and/or bryozoans. Calicular margin smooth, continuous, not jagged.

Septa regularly arranged in six systems and four complete cycles. S_1 and S_2 equal in size, slightly exsert, extending to rudimentary columella, inner edges vertical and sinuous. S_3 half as large as S_1 and S_2, not exsert, not reaching columella, with less sinuous inner edges. S_4 small, rudimentary lower in fossa, inner edges straight. Septal granulation prominent on all septa, expressed as tall (one to two times septal width in height), pointed granules arranged in poorly defined, widely spaced rows oriented obliquely to septal margins.

Fossa moderately deep, containing rudimentary, elongate columella composed of loosely fused mass of randomly arranged trabeculae; columella extending to lower, inner edges of S_1 and S_2.

Tissue in one preserved specimen reddish brown. Twelve large tentacles, positioned near stomadeum, corresponding to S_1 and S_2; 12 smaller tentacles corresponding to S_3 recessed from stomadeum; smallest tentacles (24) arranged in pairs, one pair flanking each tentacle of third cycle and recessed slightly farther from stomadeum.

Type locality: Hourglass Station "E": 27°37′N, 84°21′W; 91 m depth; about 86 nmi west of Egmont Key, Florida west coast.

Distribution: Off Florida Keys to south of Apalachicola, Florida; 91-366 m.

Etymology: The specific name *fragile* refers to the very delicate corallum composed of thin septa and theca.

Remarks: *Flabellum fragile* is extremely similar to *Rhizotrochus fragilis* Pourtalès, 1868, differing only in one important character: it does not have the 12 pairs of symmetrically arranged basal rootlets. Three other species, *Flabellum moseleyi* Pourtalès, 1880, *F. alabastrum* Moseley, 1873, and *F. angulare* Moseley, 1876, are known from the western Atlantic; all are easily distinguished from *F. fragile* by their larger sizes and different corallum shapes.

SUBORDER DENDROPHYLLIINA VAUGHAN AND WELLS, 1943
Family Dendrophylliidae Gray, 1847
Genus *Balanophyllia* Wood, 1844

Balanophyllia floridana Pourtalès, 1868

Plate II, Figures 7, 8

Balanophyllia floridana Pourtalès, 1868, p. 137; 1871, pp. 41, 42, pl. 4, figs. 5, 6; 1878, p. 207; 1880, p. 97; Bourne, 1905, pp. 206, 208; Van der Horst, 1922, p. 61; Wells, 1933, pp. 32, 35, pl. 1, figs. 8-11 [Pleistocene]; [?] Squires, 1959, p. 31; Goreau and Wells, 1967, p. 449; Macintyre, 1970, p. 178; Porter, 1972, p. 113; Wells and Lang, 1973, p. 58.

not *Balanophyllia floridana*: Pourtalès, 1874, p. 43, pl. 6, fig. 20 [=*Balanophyllia palifera* Pourtalès, 1878].

Balanophyllia palifera Pourtalès, 1878, p. 207 [in part: *Blake* Sta. 12]; 1880, p. 110 [in part: *Blake* Stas. 300, 253].

Balanophyllia florideana: Moseley, 1881, p. 190.

Balanophyllia cf. *floridana*: Chevalier, 1966, p. 1371, pl. 7, figs. 1-4.

Material examined: HOURGLASS STATION B: 1; 1 July 1967; dredge; FSBC I 15275. – 1; 11 August 1967; dredge; FSBC I 15277. – 1; 2 November 1967; dredge; FSBC I 15279. – HOURGLASS STATION C: 1; 1 December 1966; dredge; FSBC I 15261. – 1; 13 December 1966; dredge; FSBC I 15262. – 2; 6 January 1967; dredge; FSBC I 15263. – 1; 2 March 1967; dredge; FSBC I 15267. – 1; 11 September 1967; dredge; FSBC I 15278. – HOURGLASS STATION D: 2; 6 February 1967; dredge; FSBC I 15265. – 1; 3 March 1967; dredge; FSBC I 15268. – HOURGLASS STATION E: 3; 2 August 1966; dredge; FSBC I 15260. – 5; 3 March 1967; dredge; FSBC I 15269. – 1; 12 May 1967; trawl; FSBC I 15273. – 3; 2 July 1967; dredge; FSBC I 15276. – 1; 3 November 1967; dredge; FSBC I 15280. – HOURGLASS STATION K: 1; 15 February 1967; dredge; FSBC I 15266. – 1; 7 April 1967; dredge; FSBC I 15271. – 1; 6 June 1967; dredge; FSBC I 15274.

Diagnosis: Corallum straight, ceratoid to trochoid, strongly compressed; pedicel usually attached to substrate, sometimes free; costae thin, equal, set apart by deep, narrow intercostal grooves; adult specimens often with full fifth cycle plus some S_6, septa arranged in Pourtalès Plan; fossa deep; elongate columella spongy.

Types: Three lots totalling 20 syntypes are deposited at the MCZ; one contains 16 specimens (5475), another, three (5475), and the third lot, one (5585). All are labelled 26-63 fms and are presumably from *Bibb* Sta. 52. The syntypes from off Havana were not found.

Type locality: Straits of Florida; 48-115 m.

Distribution: Western Atlantic: from Onslow Bay, North Carolina (34°N) through the Straits of Florida; west coast of Florida to off Apalachicola; Jamaica; Lesser Antilles; off Panama; off Louisiana (Pleistocene). Eastern Atlantic: off Senegal; Gulf of Guinea. Depth range 18-183 m. Squires' (1959) record from Bermuda, although not unlikely, is impossible to verify because of the worn condition of the specimen. Pourtalès' (1868) report of worn specimens from off Havana at 494 m was probably of some transported there after death.

Remarks: A detailed description of this species is being prepared by the author as part of a larger review of all western Atlantic *Balanophyllia*. Of the seven other valid species (Cairns, 1976) of

Balanophyllia from the western Atlantic, *B. floridana* is most similar to *B. cyathoides* (Pourtalès, 1871). *Balanophyllia floridana* can be distinguished by its less exsert S_1, equal S_1 and S_2, and presence of S_5 and even S_6, both of which are rare in *B. cyathoides*.

DISCUSSION

ZOOGEOGRAPHY

Because the deep water coral fauna of the Gulf of Mexico is still poorly known, particularly that of the central basin and western coast, it is still not possible to analyze reliably its zoogeographic affinities. However, a preliminary analysis can be made based on this paper and the distributions discussed by Cairns (1976). Among the 31 ahermatypic species known from the eastern Gulf of Mexico (excluding *Sphenotrochus* sp.), 15 (48.5%) are amphi-Atlantic, 14 (45%) are tropical western Atlantic, and two (6.5%) are cosmopolitan (Table 3). In comparison, Cairns (1976),

TABLE 3. ZOOGEOGRAPHIC AFFINITIES OF EASTERN GULF OF MEXICO AHERMATYPIC CORALS.

Amphi-Atlantic	Tropical Western Atlantic	Cosmopolitan
Paracyathus pulchellus	*Caryophyllia horologium*	*Javania cailleti*
Dasmosmilia lymani	*Caryophyllia maculata*	*Stenocyathus vermiformis*
Balanophyllia floridana	*Flabellum fragile*	
Fungiacyathus crispus	*Madracis myriaster*	
Cladocora debilis	*Madracis* sp. cf. *asperula*	
Astrangia astreiformis	*Astrangia solitaria*	
"Thecocyathus" laevigatus	*Madrepora carolina*	
Deltocyathus italicus	*Oculina tenella*	
Dasmosmilia variegata	*Caryophyllia berteriana*	
Anomocora fecunda	*Trochocyathus rawsonii*	
Coenosmilia arbuscula	*Deltocyathus calcar*	
Asterosmilia prolifera	*Bathypsammia tintinnabulum*	
Guynia annulata	*Enallopsammia profunda*	
Schizocyathus fissilis	*Phyllangia americana*	
Peponocyatus stimpsonii		

analyzing all 108 species of ahermatypes from the tropical western Atlantic, found the following components: 65% western Atlantic endemic, 25% amphi-Atlantic, and 8% cosmopolitan. The high number of endemic species was explained as a reradiation after the more or less simultaneous appearance in the Miocene-Pliocene of the Central American land bridge, which interrupted the previously continuous, circumtropical Tethys Sea, and a climatic deterioration, which destroyed much of the tropical fauna of the western Atlantic. The substantial (25%) amphi-Atlantic component reflects a current or recent communication across the Atlantic, particularly by deeper water slope species. It is premature to speculate about the exceptionally high (48.5%) amphi-Atlantic component of the eastern Gulf fauna; however, it may be simply the result of biased collecting.

It is also noted that the eastern Gulf fauna has a much stronger affinity to the tropical western Atlantic fauna than to the temperate western Atlantic fauna. None of the six ahermatypic species endemic to the northwest Atlantic temperate fauna is found in the Gulf of Mexico, whereas 42% of the eastern Gulf species are endemic to the tropical western Atlantic.

BATHYMETRY

The 32 eastern Gulf ahermatypes can be divided into four ranges (Table 4). Five species (16%)

TABLE 4. BATHYMETRIC GROUPINGS OF EASTERN GULF OF MEXICO AHERMATYPIC CORALS.

Shallow water (0-50 m)	Shelf (50-200 m)	Upper Slope (deeper than 200 m)	Shelf/Slope (30-400 m)
Cladocora debilis	*Caryophyllia horologium*	*Trochocyathus rawsonii*	*Madrepora carolina*
Astrangia astreiformis	*Caryophyllia maculata*	*Fungiacyathus crispus*	*Madracis myriaster*
Astrangia solitaria	*Dasmosmilia lymani*	*Caryophyllia berteriana*	*Paracyathus pulchellus*
Phyllangia americana	*Balanophyllia floridana*	*"Thecocyathus" laevigatus*	*Flabellum fragile*
Sphenotrochus sp.	*Madracis* sp. cf. *asperula*	*Deltocyathus italicus*	*Asterosmilia prolifera*
	Oculina tenella	*Deltocyathus calcar*	*Guynia annulata*
		Dasmosmilia variegata	*Peponocyathus stimpsonii*
		Stenocyathus vermiformis	
		Bathypsammia tintinnabulum	
		Enallopsammia profunda	
		Schizocyathus fissilis	
		Coenosmilia arbuscula	
		Javania cailleti	
		Anomocora fecunda	

belong to a very shallow water environment in the same depth range as hermatypic corals. Six species (19%) belong to a shelf habitat, rarely found below 200 m. The largest number of species, 14 (44%), occurs only on the upper slope, rarely found above 200 m, and rarely extending below 1000 m. A fourth group, termed "shelf/slope" (*i.e.*, 30-400 m), composed of seven (22%) species forms a transition between the shelf and upper slope species. Among the species in Hourglass collections, only *Balanophyllia floridana* was collected shallower than 73 m. Three species appeared only in the single collection from 91 m. Because the Hourglass stations did not extend deeper than 91 m, of the six species collected, four (*C. horologium, C. maculata, D. lymani*, and *B. floridana*) belong to the shelf fauna, and two (*P. pulchellus* and *F. fragile*) belong to the "shelf/slope" group.

The bathymetric distributions of the 32 eastern Gulf species are very similar to those discussed by Cairns (1976), based on 108 species. He found these components: 10% shallow water, 18% shelf, 58% slope, and 13% "shelf/slope." The smaller slope and higher shallow water component figures for the eastern Gulf probably represent an uneven collecting effort in the Gulf, with much more intensive collecting in shallow water.

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PLATE I

Figure 1. *Caryophyllia maculata*: Hourglass Station M, calicular diameter 18.5 x 16.4 mm; FSBC I 15283.

Figure 2. Same specimen, height 16.4 mm.

Figure 3. *Caryophyllia maculata*: better preserved specimen collected off Cozumel, Mexico; greater calicular diameter 19.3 mm; USNM 46811.

Figure 4. *Caryophyllia horologium* (holotype): Hourglass Station "E", height 18.8 mm; USNM 45760.

Figures 5,6. Same specimen, calicular diameter 14.6 x 10.9 mm, stereo pair of calice.

Figure 7. *Dasmosmilia lymani*: Hourglass Station E, height 29.4 mm; FSBC I 15285.

Figure 8. Same specimen, calicular diameter 18.4 x 10.9 mm.

Figure 9. *Caryophyllia horologium* (paratype): Hourglass Station "E", calicular diameter 13.5 x 12.0 mm; USNM 45762.

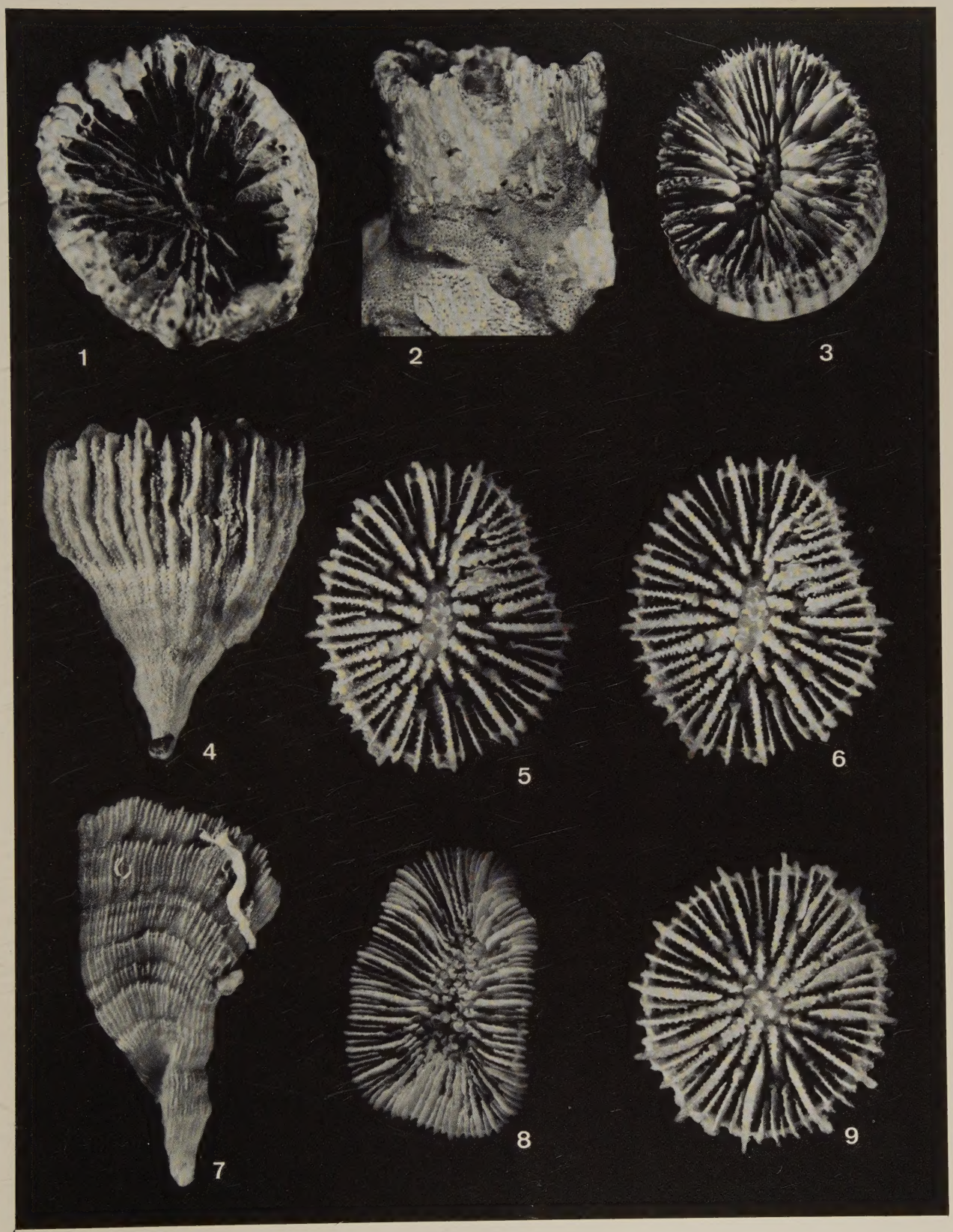
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PLATE II

Figure 1. *Flabellum fragile* (paratype): southeast of Alligator Reef, Florida, calicular diameter 20.0 x 17.4 mm; USNM 45767.

Figure 2. *Paracyathus pulchellus*: Hourglass Station "E", calicular diameter 9.7 x 8.8 mm; FSBC I 15284.

Figure 3. Same specimen.

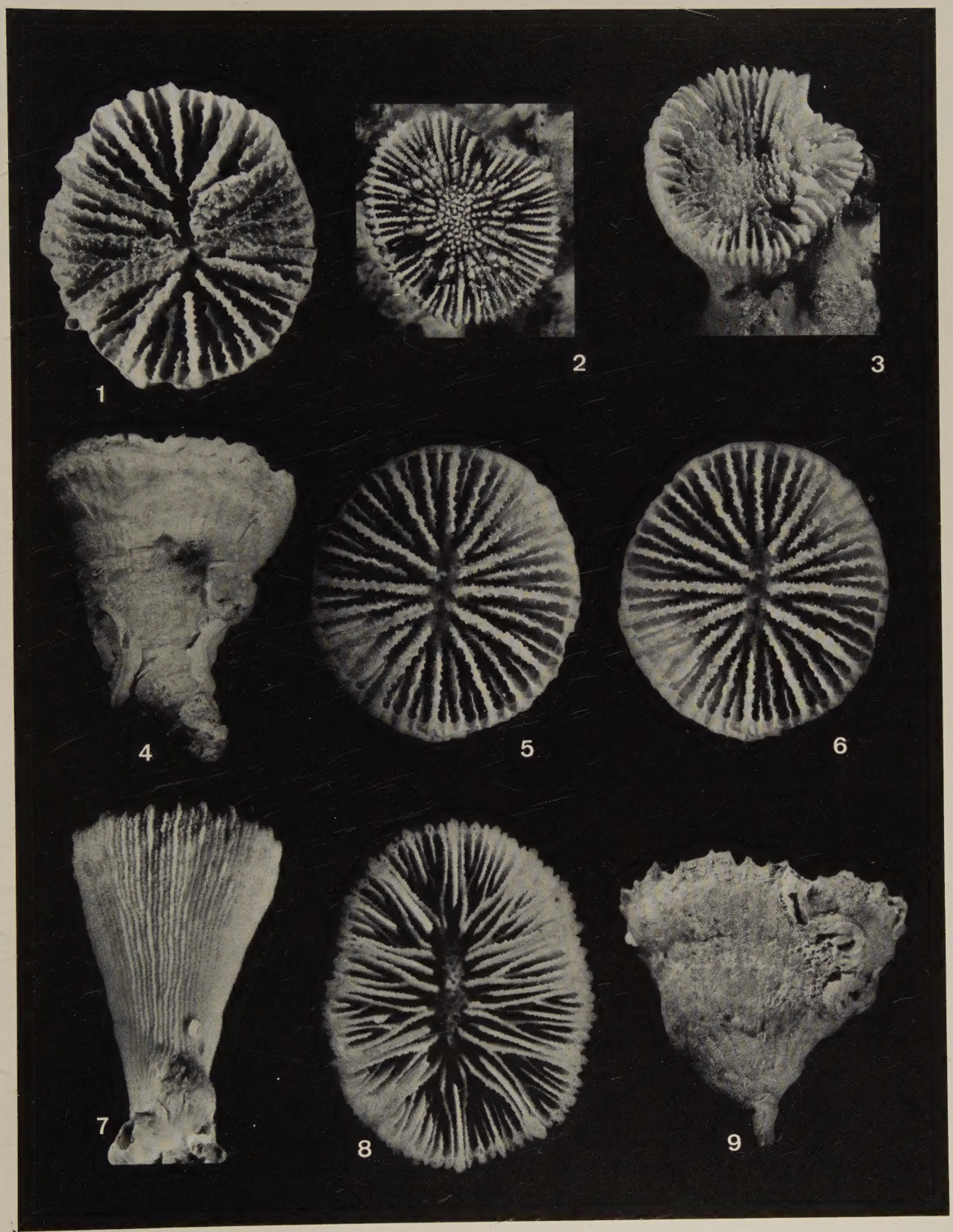
Figure 4. *Flabellum fragile* (holotype): Hourglass Station "E", height 19.4 mm; USNM 45764.

Figures 5,6. Same specimen, calicular diameter 18.2 x 16.6 mm, stereo pair of calice.

Figure 7. *Balanophyllia floridana*: 28°37.1′N, 80°04.8′W, 64 m, off Cape Canaveral, Florida east coast, height 28.7 mm; FSBC I 15281.

Figure 8. Same specimen, calicular diameter 18.5 x 14.0 mm.

Figure 9. *Flabellum fragile*, same specimen as in Figure 1, height 17.2 mm.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